Master on Industrial Electronics and Computers Engineering

Specialization on Control, Automation and Robotics

Autonomous Intelligent Systems 2023/2024:

Project 2 Middle Evaluation

16/04/2024

Group 4: RIMA Robotics

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Agenda:

- Timetable;
- Requirements and Constraints;
- System Overview Diagram;
- Subsystem Diagram
  - Mobile Robot;
  - Robotic Arm;
  - ConveyorIn;
  - Parking System;
- State Machine Simplified;
- State Machine Detailed;
- Tests
  - Conveyor;
  - Mobile Robot;
  - Robotic Arm;
- Next Steps;

Timetable:

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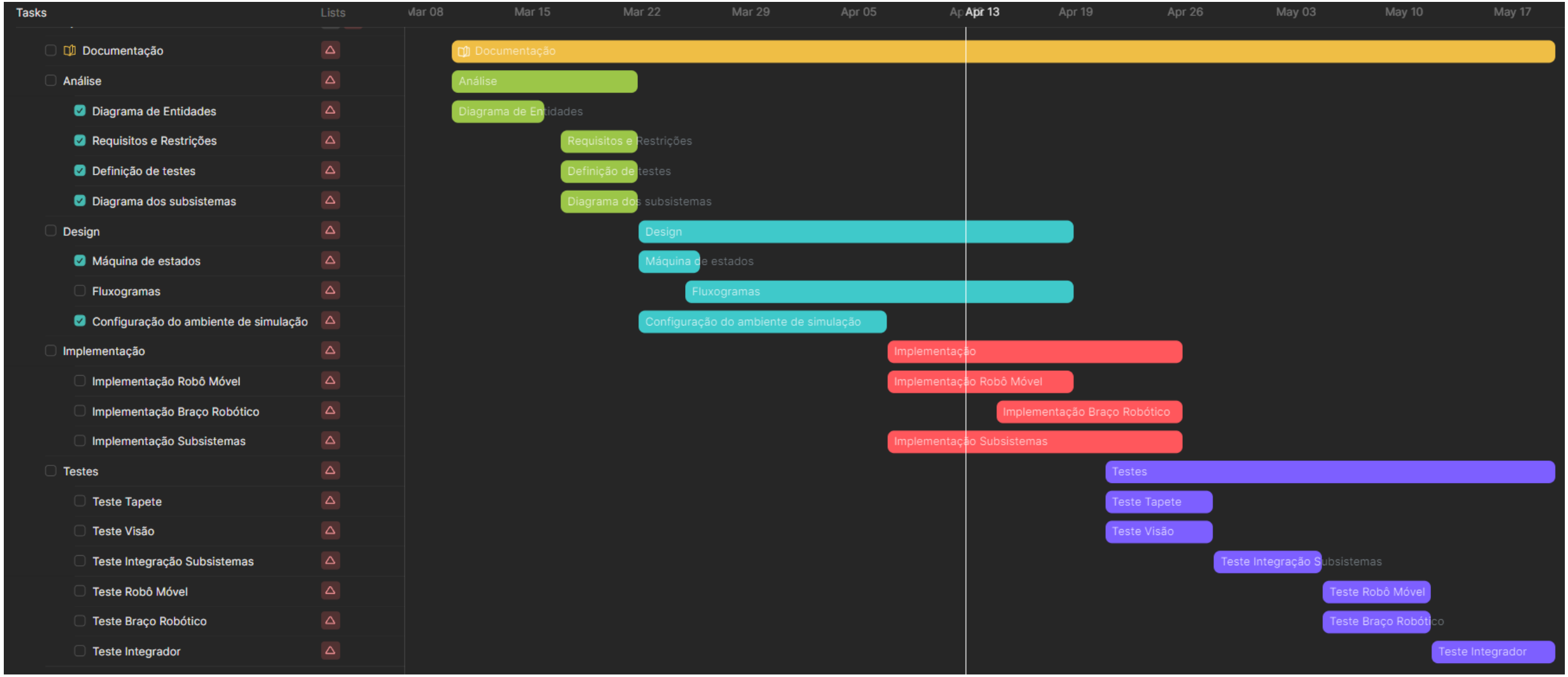

Requirements and Constraints:

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Requirements:

1. Functional

- Development of an autonomous movement algorithm for a mobile robot;
- Development of a control algorithm for a robotic arm;
- Object detection system;
- Obstacle detection system;
- Integration of subsystems for the pick-and-place;

2. Non-Functional

- Movement optimization;
- Precision when grabbing/landing objects;
- Intuitive movements;

Restrictions:

1. Technical

- Use of the Coppelia simulation platform;
- Grasping only one box at a time;
- Utilization of Matlab as the programming language;
- Utilization of the mobile robot KUKA;
- Utilization of the robotic arm LBR iisy (6 DOF), UR10e (6 DOF), KUKA LBR iiwa (7 DOF);

2. Non-Technical

- Project design deadline until May 24, 2024;;
- Group of 4 members;

Tests:

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Conveyor Test:

- Conveyor control for sending and receiving boxes;
- Sensor system to assess the presence and identification of the box ;

Mobile Robot Test

- Autonomously control omnidirectional movement of the robot;
- Obstacle avoidance;
- Stop for unloading and picking up objects;

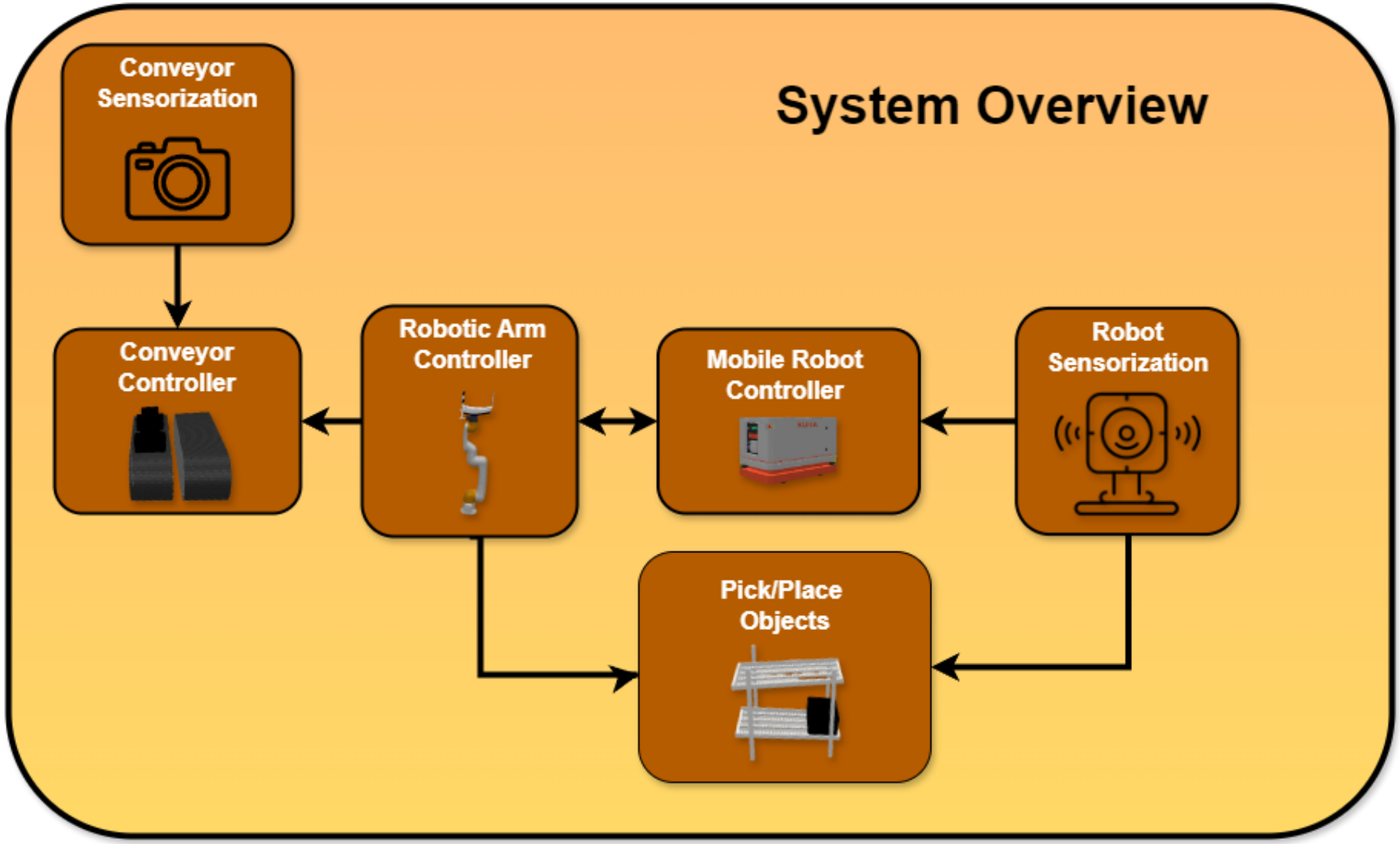
Simulation Objects Test:

- Determine the behavior of the boxes with the other systems;
- Definition of the appearance of the boxes on the carpet;
- Definition of the disappearance of the boxes on the shelf;

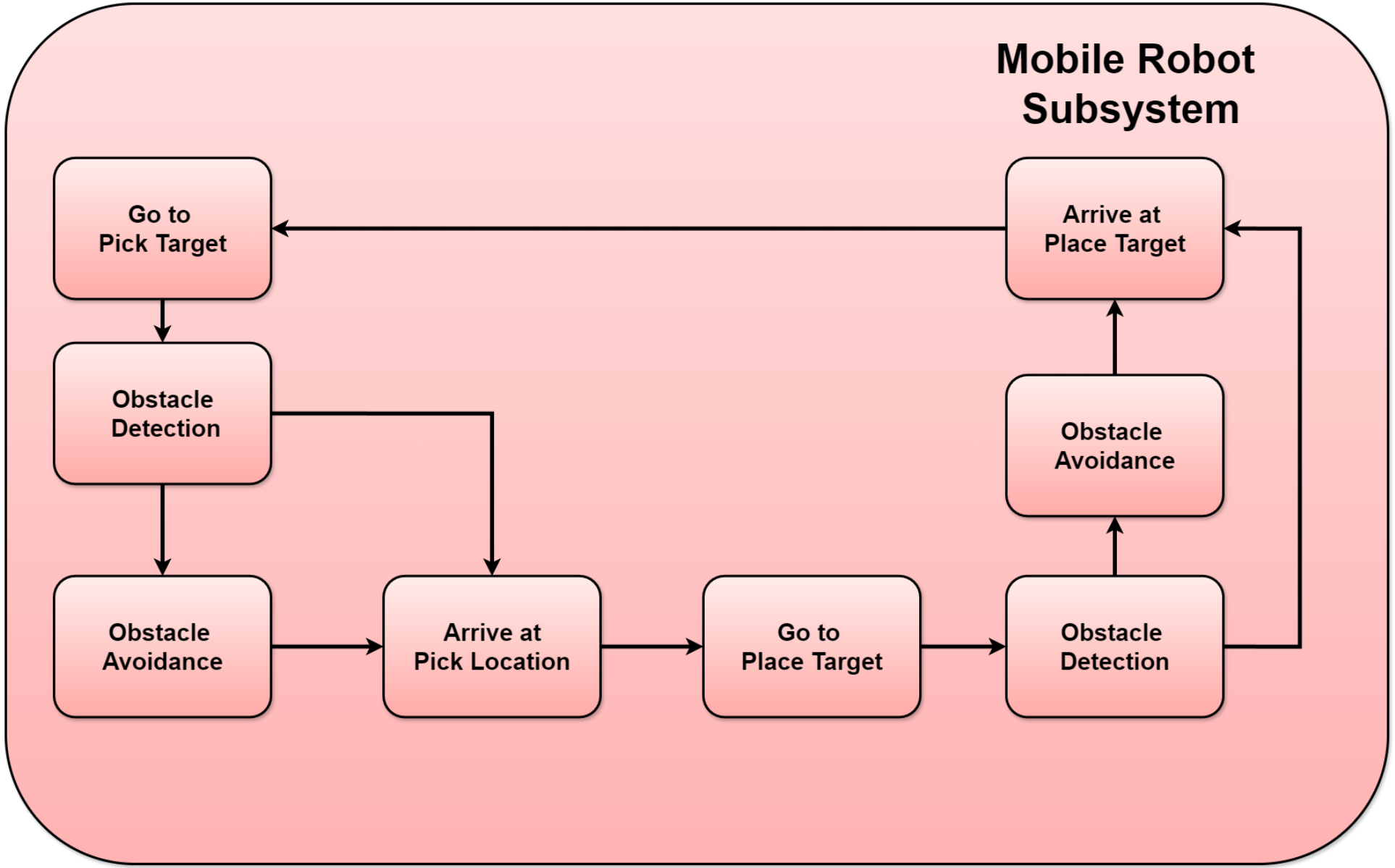
Robotic Arm Test

- Definition of the movement to pick up a box from the carpet and deliver it to the shelf;
- Definition of the movement to pick up a box from the shelf and deliver it ti the carpet;
- Arm position for transportation;
- Define motion settings;
- Define resting position;

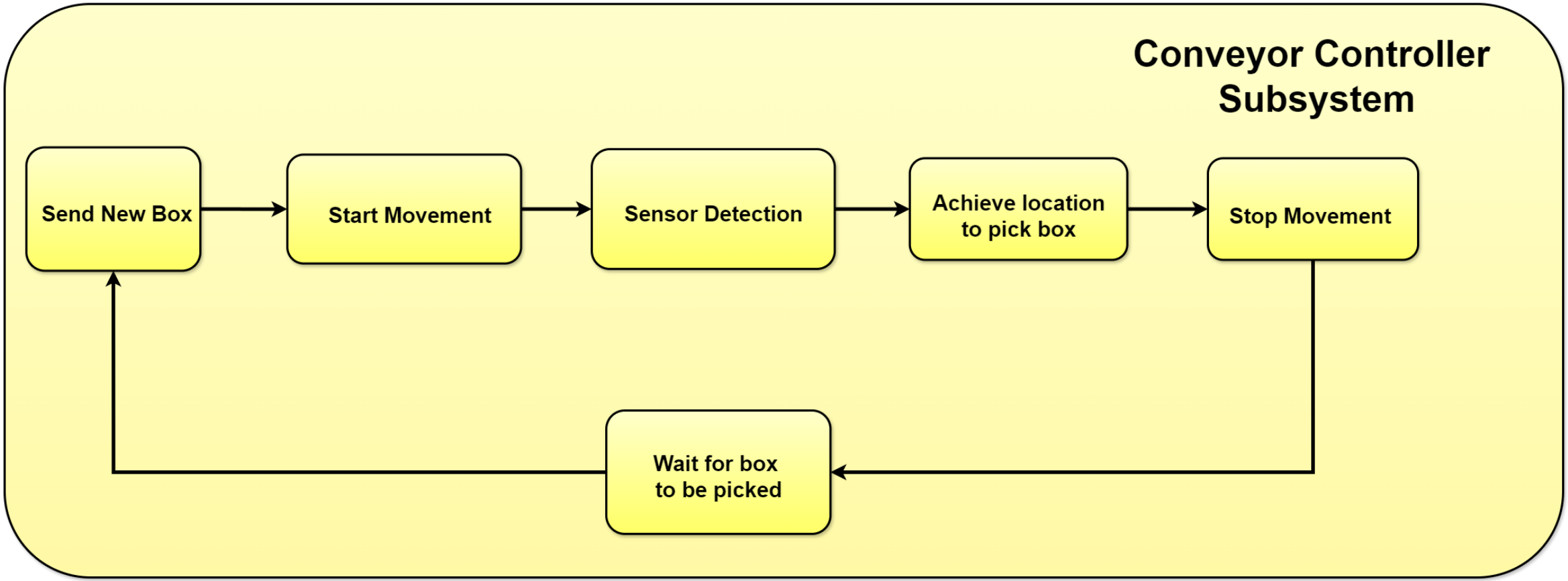
System Overview:



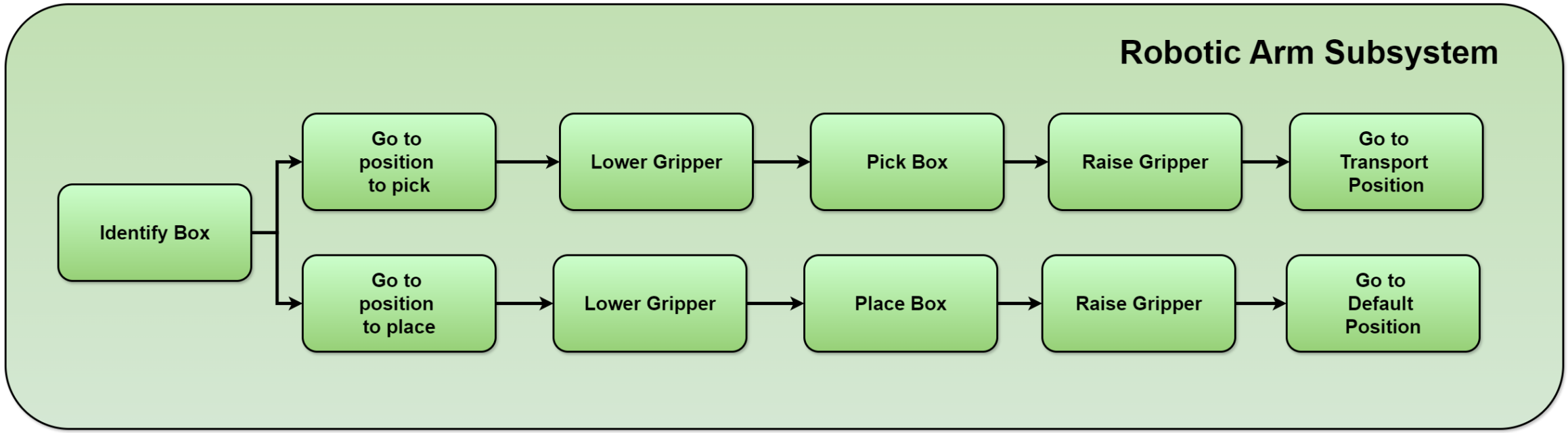
Subsystems Diagram:



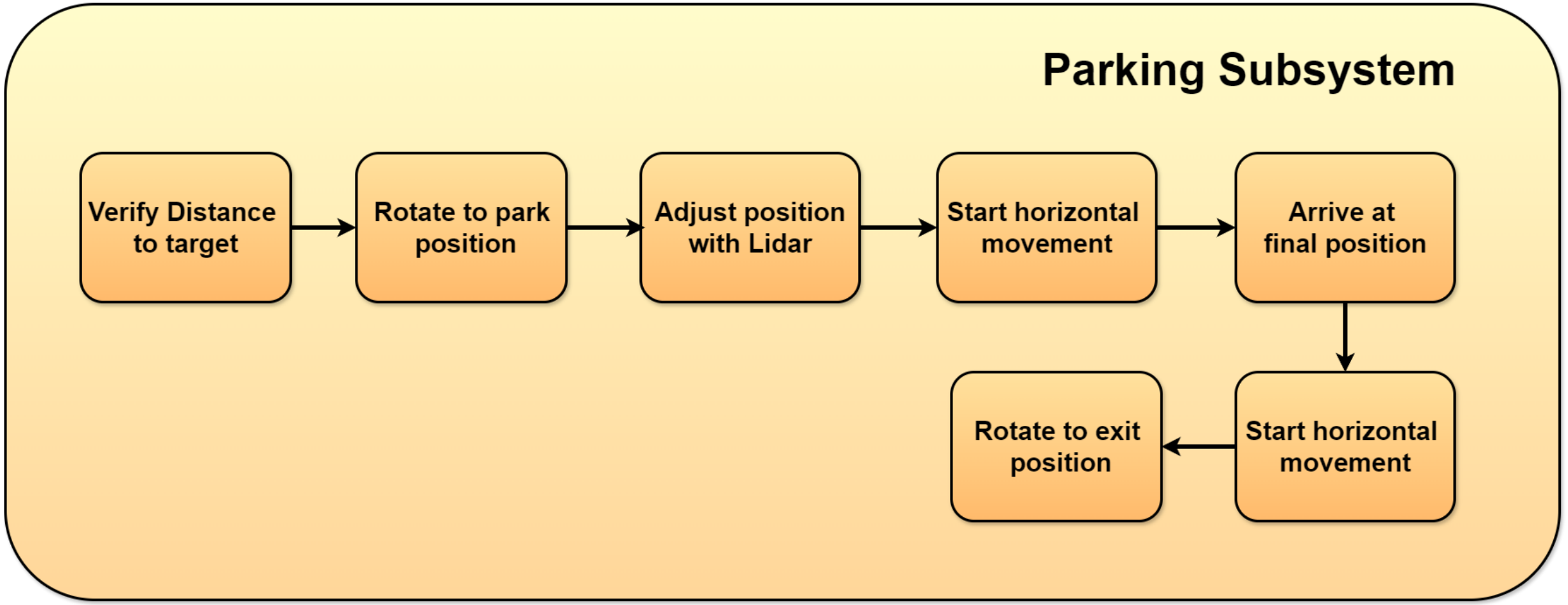
Subsystems Diagram:



Subsystems Diagram:



Parking Algorithm:



State Machine (Simplified):

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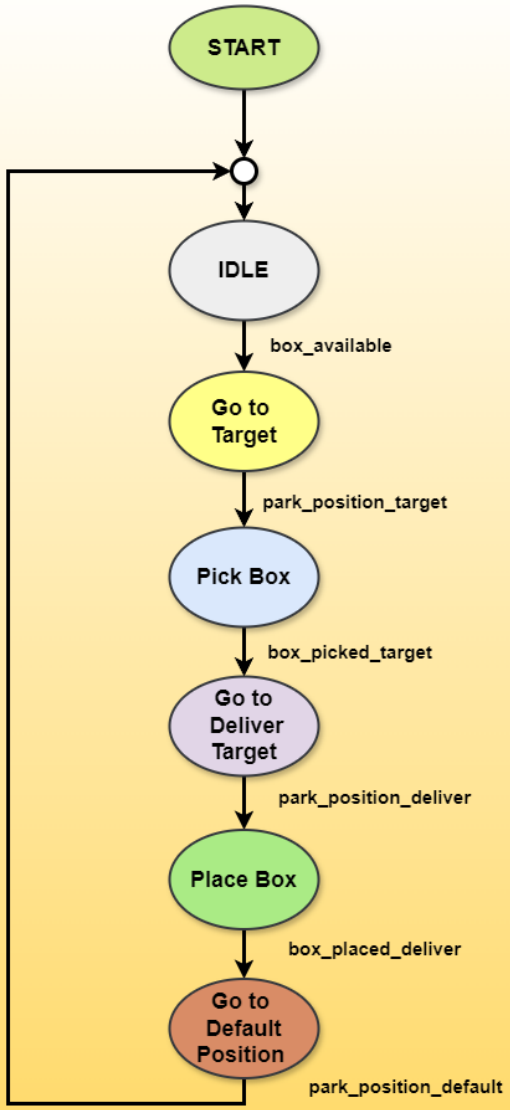
State Machine Simplified

Subtitle	
box_available	- Check if there is a box to be picked
park_position_target	- Verify if robot is in the position to pick the target
box_picked_target	- Check if Robot picked the target
park_position_deliver	- Verify if robot is in the position to deliver target
box_placed_deliver	- Check if Robot delivered the target
park_position_default	- Verify if Robot is in the deafult position (standby)



State Machine (Detailed):

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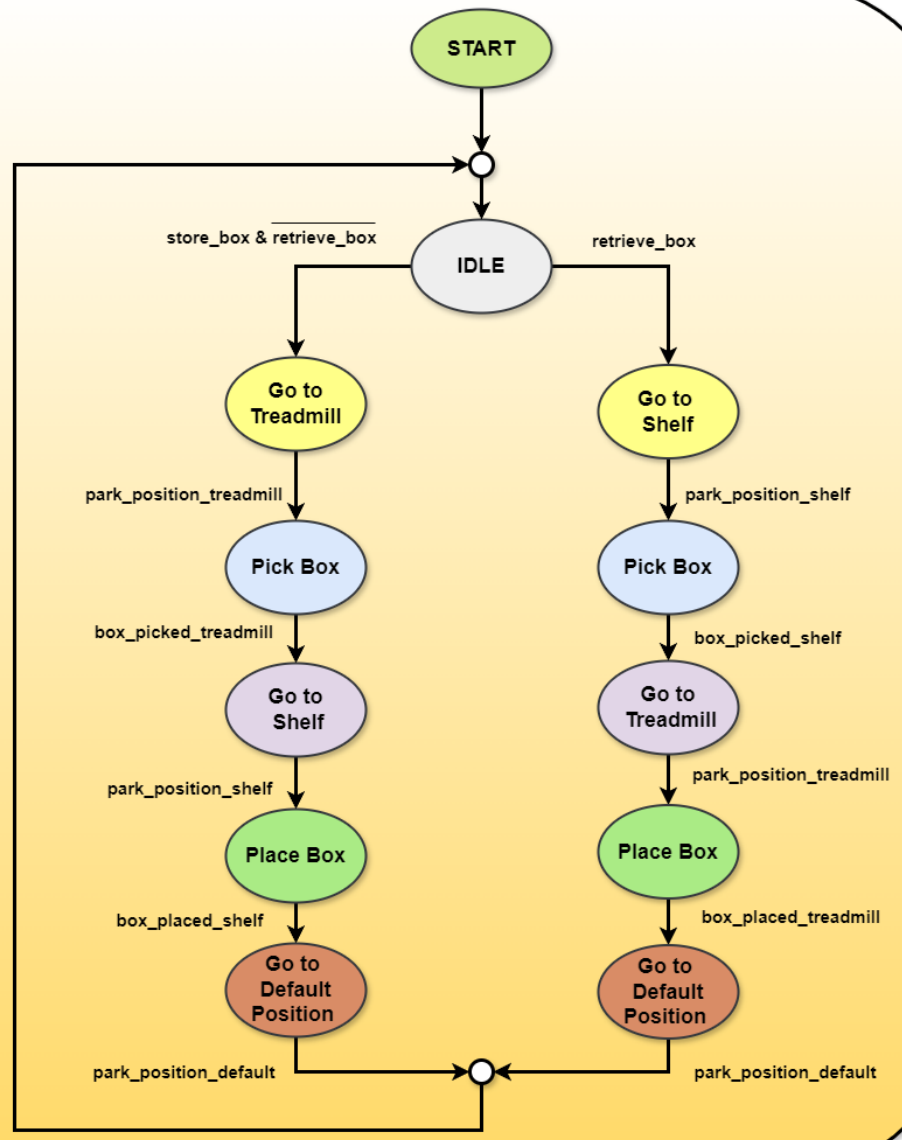
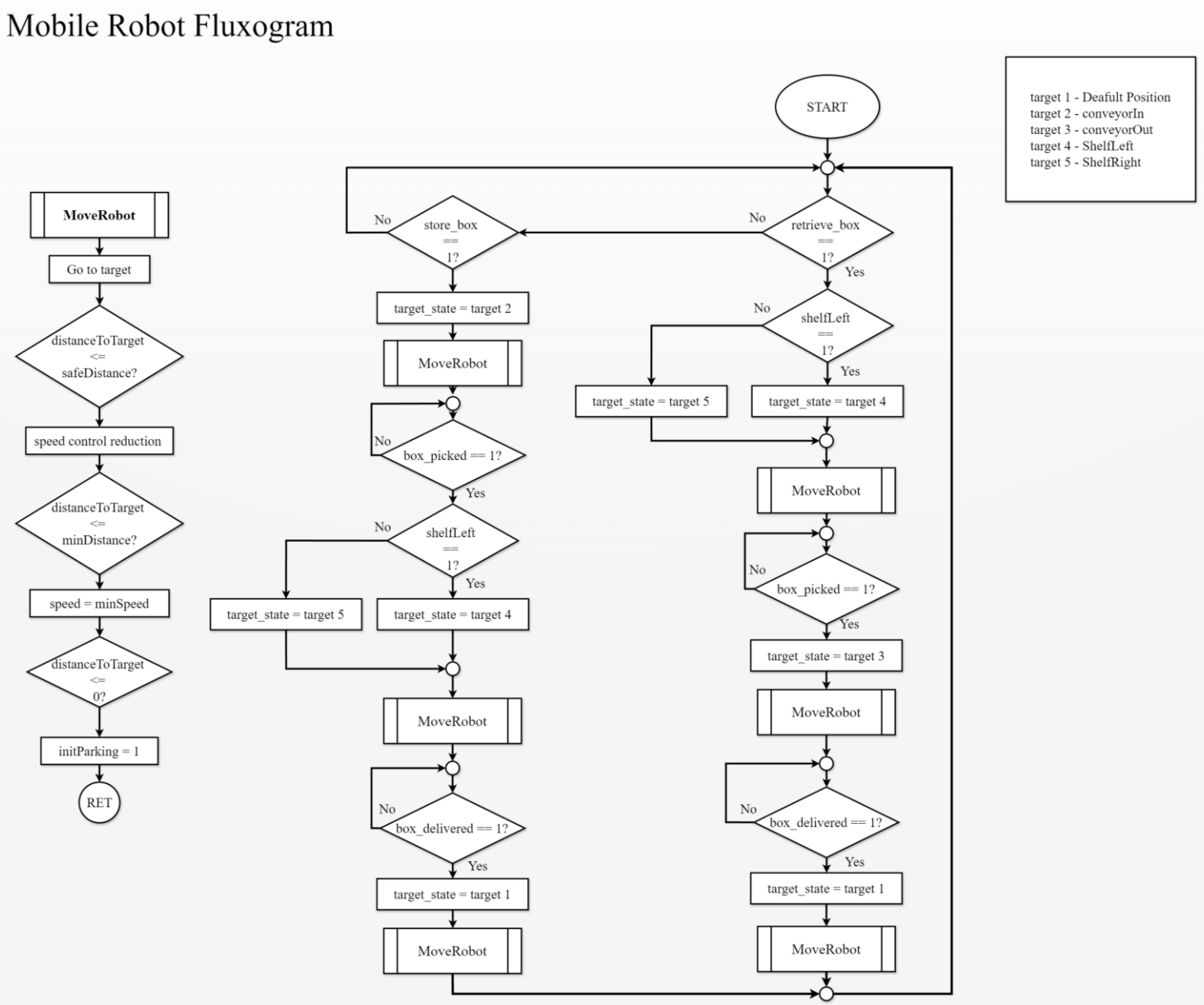
State Machine Detailed

Subtitle	
store_box	- Check if there is a box to be stored in a shelf
retrieve_box	- Check if there is a box to be retrieved from a shelf
park_position_treadmill	- Verify if robot is in the position to pick box from treadmill
park_position_shelf	- Verify if robot is in the position to pick box from shelf
box_picked_treadmill	- Check if Robot picked the box from treadmill
box_picked_shelf	- Check if Robot picked the box from shelf
park_position_shelf	- Verify if robot is in the position to deliver box in the shelf
park_position_treadmill	- Verify if robot is in the position to deliver box in the treadmill
box_placed_shelf	- Check if Robot delivered the box in the shelf
box_placed_treadmill	- Check if Robot delivered the box in the treadmill
park_position_default	- Verify if Robot is in the deafult position (standby)



Mobile Robot Fluxogram:



Robotic Arm Fluxogram:

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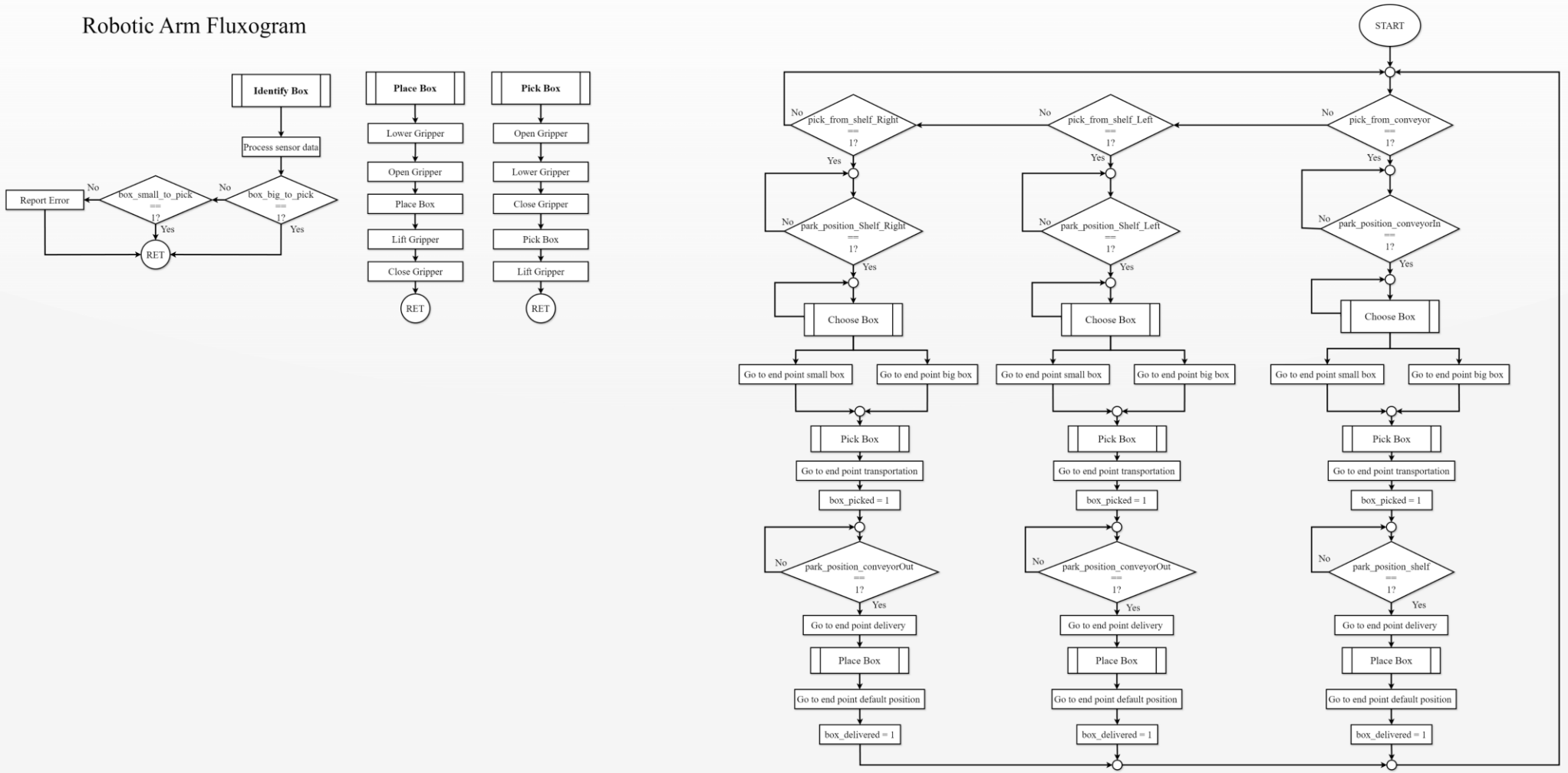
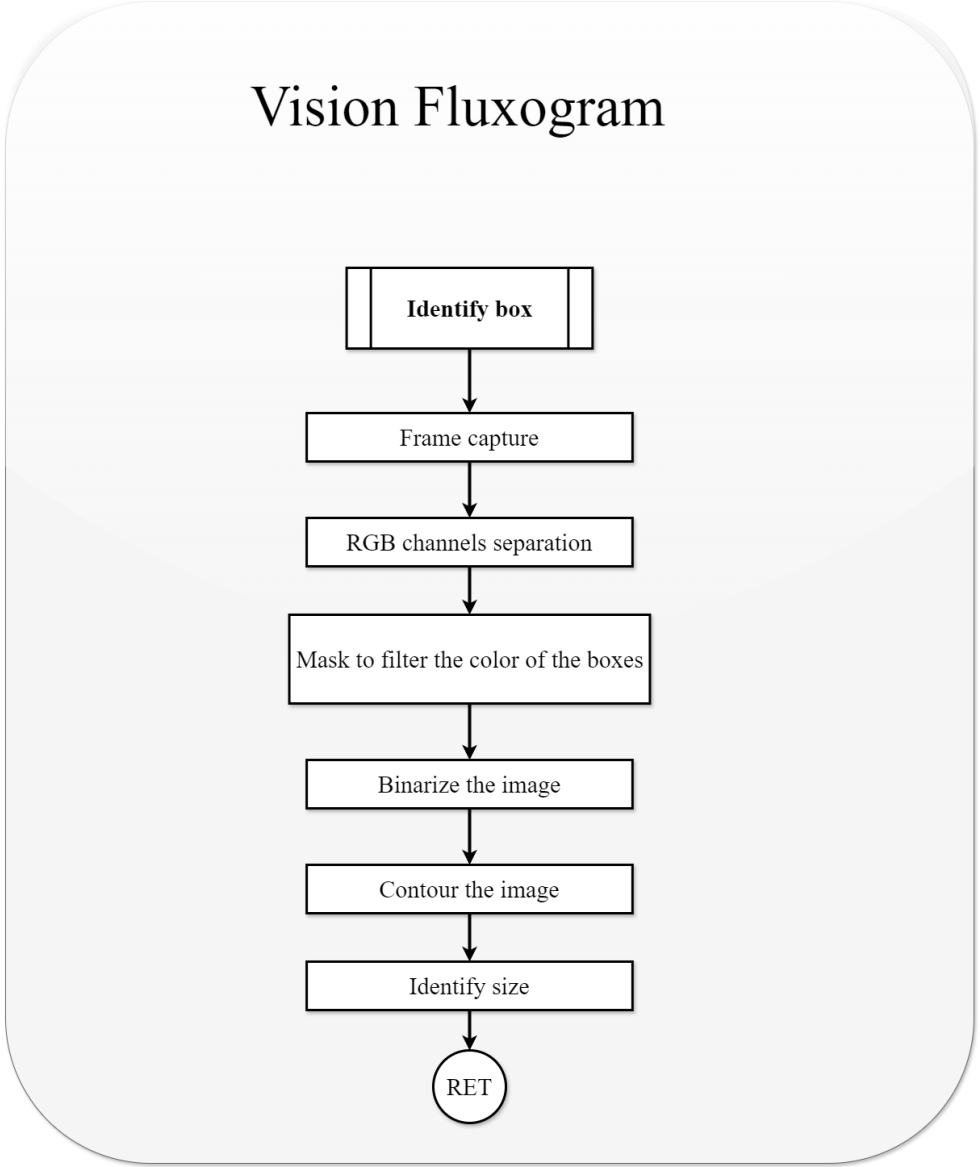


Vision Algorithm Fluxogram:



Vision Algorithm Test:

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Original Image

Image without black color

Binary Image

Image with contours

Conveyor Communication Test:

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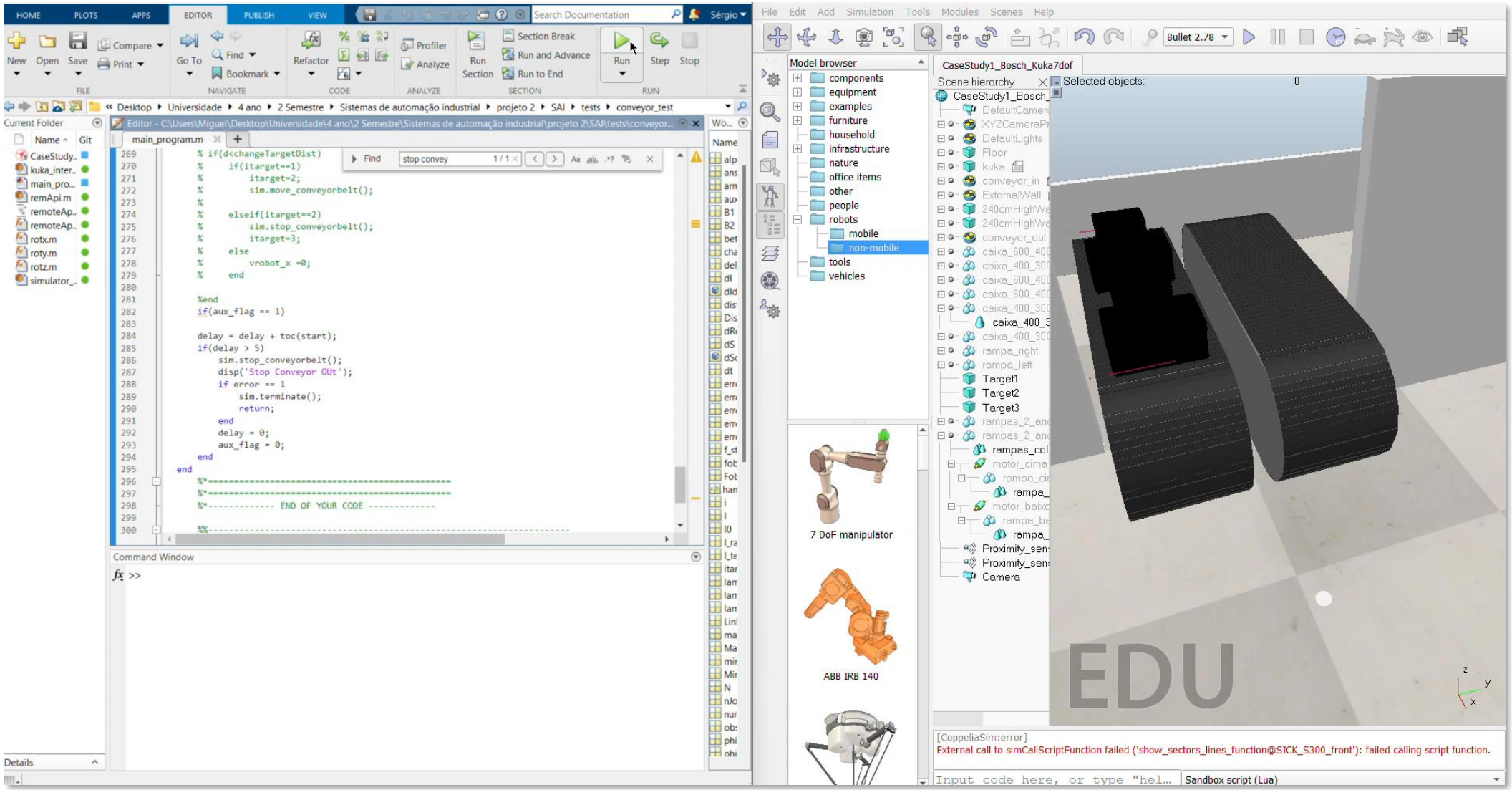

Robotic Arm Communication Test:

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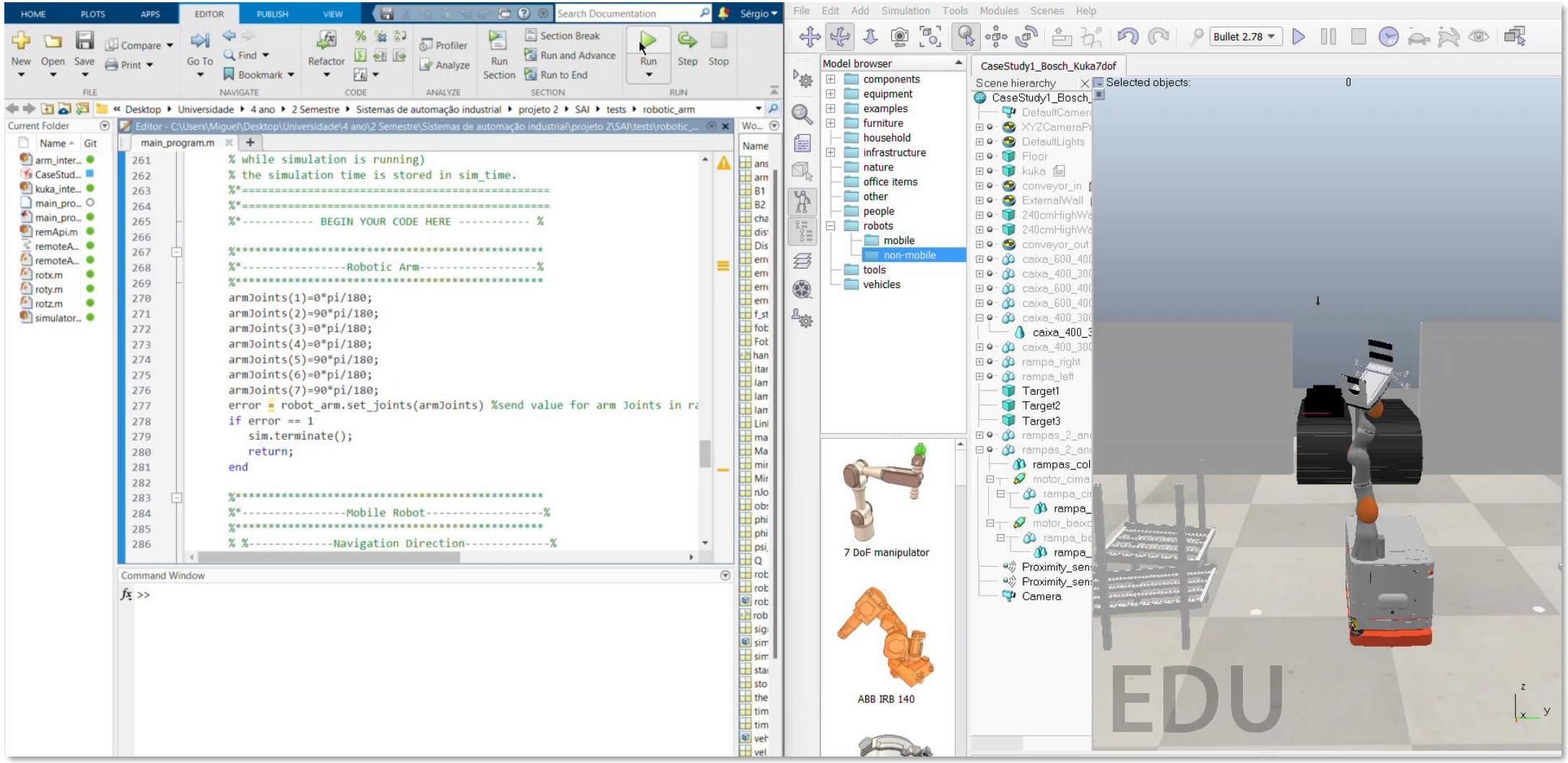

Initial Integration Test:

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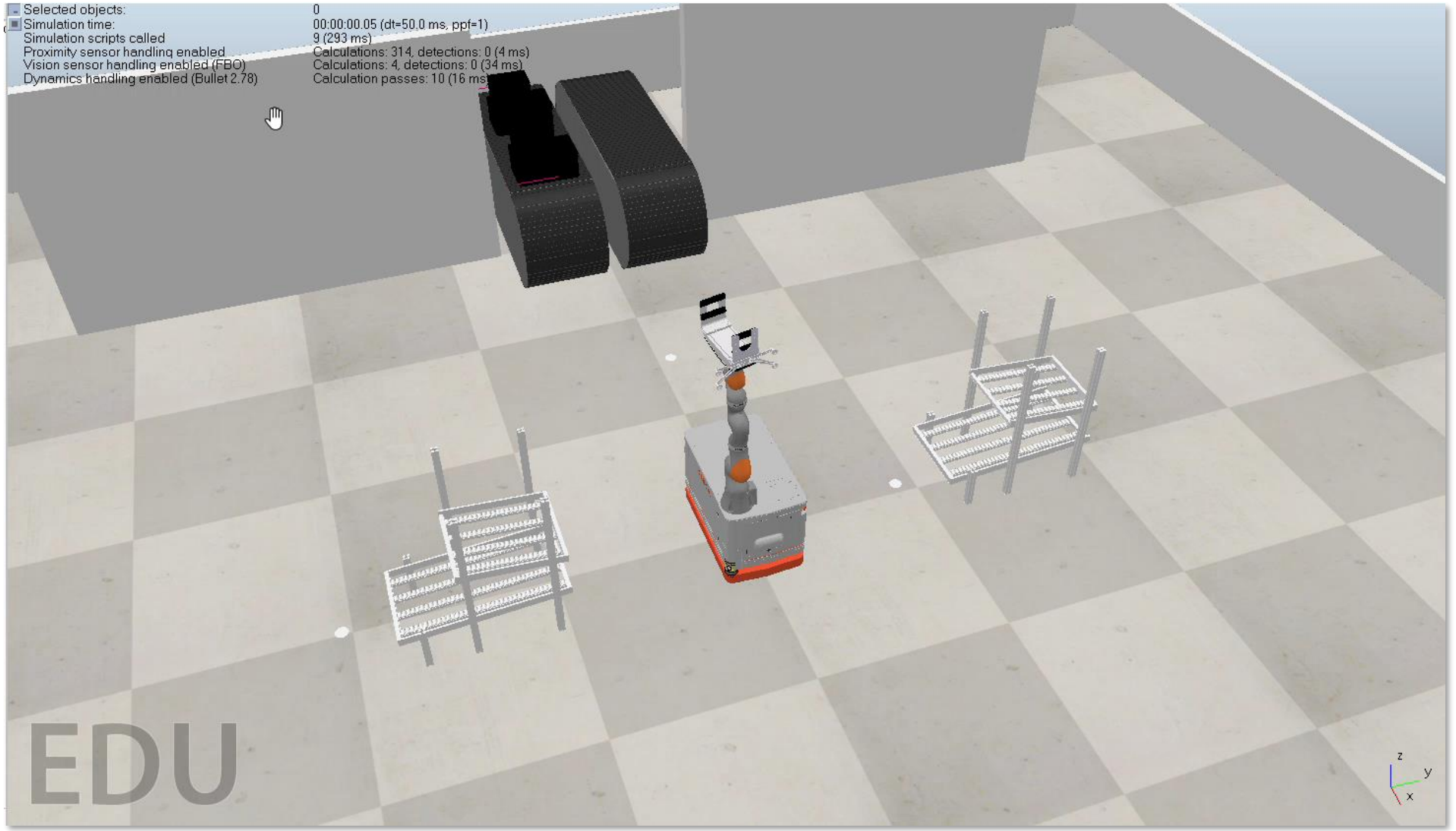

Next Steps:

- Optimize speed control system;
- Conveyor controller implementation;
- Optimize Mobile Robot implementation;
- Begin parking algorithm implementation;
- Implementation of state machine (initial draft);
- Design and implementation of the image processing system;

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Thank you!
Any questions?

May the force be with you!